

CUSTOMER NO.: 24498
Serial No. 10/583,822
Office Action dated: 06/08/09
Response dated: 10/08/2009

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Remarks/Arguments

Claims 17-20, 22-24 and 26 are pending in the Application. Claim 17-20, 22-24 and 26 are rejected by Examiner. Claims 17 and 23 are amended by Applicant. Claims 27-29 have been added. Claim 19 is cancelled in this amendment without disclaimer or prejudice. Claims 17 and 23 have also been objected to.

Amendments to the Claims

Claim 17 has been amended to more clearly recite a circuit, in which a common control signal line is connected to the control electrodes of the current control means of a multiplicity of elements via a series connection of two switching means in such a way that a corresponding multiplicity of current mirror circuits connected in parallel are formed when the series connection of the two switching means of the multiplicity of elements is conducting. This amendment is fully supported at least by Figure 12 and the description thereof.

Claim 19 has been cancelled.

Claim 23 has been amended to provide consistent wording.

Claim 27 has been added, incorporating the combination of claim 17 and cancelled claim 19 in an independent claim.

Claims 28 and 29 correspond to claims 20 and 22 and refer back to claim 27.

No new matter has been added.

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Objections to the Claims

Claims 17 and 23 have been objected to for using improper antecedent basis within the claim. Claims 17 and 23 have been amended as suggested by the Examiner. As such, Applicant respectfully requests that the Examiner withdraw the objection to Claims 17 and 23.

Claim Rejections Pursuant to 35 U.S.C. §112

Claim 19

Claim 19 has been rejected under 35 U.S.C. § 112 as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 19 has been cancelled in this response rendering the rejection to the claim 19 moot.

Claim Rejections Pursuant to 35 U.S.C. §103

Claims 17-20, 22-24 and 26

Claims 17-20, 22-24 and 26 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,917,350 to Pae et al. ("Pae") in view of U.S. Patent No. 7,138,967 to Kimura ("Kimura"). Applicant respectfully traverses the rejection.

The present application involves selectively coupling one half of a current mirror to one or a group of pixel cells, each one comprising only the other half of the current mirror circuit. Thus, when the two serially connected switches of a pixel cell of the inventive circuit are closed, the half-circuit of a current mirror of the respective pixel cell is operatively connected to the other half-circuit external to the pixel cell. The reference current ramp flowing through the external half of the so-established current mirror is identically copied into each one of the connected pixel cells that has

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both switches closed. This in turn only requires determining, or measuring, the reference current in a single point in the circuit, while still being able to know the current actually flowing in each one of the connected pixel cells. When the actual reference current reaches a level that equals the desired level for one of the pixel cells that is operatively connected in a current mirror circuit it is sufficient to open one of the two switches for that particular pixel cell. When a signal holding means is connected, this level will be maintained until it is reprogrammed. Otherwise the current flow in the disconnected pixel cell will decay and eventually cease. Applicant maintains that this is a concept that is not disclosed, taught or suggested in either Pae or Kimura, or the combination thereof.

The present application advantageously allows for programming a multiplicity of pixel cells *simultaneously* using only one single current ramp signal, and one single current measuring means provided in the driving circuit. This is an advantage because using current mirrors, or current sources in general, involves comparatively large impedances at the source side of the circuit, which may lead to slow programming due to resistances and parasitic capacitances in the circuit. If individual pixel cells were to be programmed one after the other, the slow programming may limit the refresh rate of the display. Slow programming in the current programming mode may be compensated for by providing a number of parallel circuits for programming cells in parallel, but this would undesirably increase the circuit complexity. As will be shown in the following, this and other problems are not even remotely addressed by Pae or Kimura, and as such there is no disclosure, teaching or suggestion in either of Pae or Kimura to use a circuit and a method as claimed in the present invention.

Pae discloses a driving circuit of an active matrix display device. The driving circuit includes a switching unit selectively switching a current supplied from a driving unit to the light emitting device or to a deviation compensator. The deviation compensator detects the magnitude of the current supplied from the driving unit and

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controls a control voltage that is applied to the driving unit in response to a reference voltage, thereby compensating luminance deviation of the display device according to threshold voltage deviation of the driving unit (see abstract). The compensation disclosed in Pae is effected by routing a current that is controlled by a current control means (P0 in Figure 2) via a switch (P3 in Figure 2) to a compensating unit (circuit shown in Figure 3). The compensation unit includes a current-to-voltage converter 21. The current from the current control means is converted into a voltage and is fed to a comparator, where it is compared to a reference voltage that is also fed to the comparator. The output of the comparator controls a sample and hold circuit. A ramp-shaped voltage signal is supplied to the input of the sample and hold circuit. The output of the sample and hold circuit is fed to the control electrode of the current control means. When the voltage that corresponds to the current through the current control means exceeds a threshold set by the reference voltage that is fed to the comparator, the output of the comparator triggers the sample and hold circuit such that the momentary voltage of the ramp-shaped voltage signal is maintained. The driving process described above is performed during a period T4, after which the current provided by the current control means is routed to a light emitting means (OEL in Figure 2). The alternate routing of the current through the current control means to either the light emitting means or the deviation compensator can clearly be seen in the signal waveforms of Figure 4. There, the selection signal SEL and the inverted selection signal /SEL are shown, which, in Figure 2 control switches P2 and P3 in such a way that one of them exclusively conducts, while the other is opened.

Nothing in Pae discloses, teaches or suggests providing a deviation compensator circuit as shown in Figure 3 with each and every light emitting element. In fact, the output of the deviation compensator circuit, i.e. signal "ramp", appears to be connected to 'data line (ramp)' of Figure 2. The way 'data line (ramp)' is drawn in Figure 2 clearly indicates that this data line is connected to a multiplicity of light emitting elements and their associated circuitry.

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The whole control process disclosed in Pae necessarily requires individually controlling the current control means of each and every light emitting means of the display. Applicant acknowledges that Figure 2 of Pae suggests that a number of light emitting means and associated circuitry is connected to the same 'data line (ramp)'. However, the totality of the disclosure of Pae teaches the sequential connection of the deviation compensator and individual light emitting means and their associated circuitry that are connected to the same 'data line (ramp)'. The method and circuit of Pae clearly does not allow for providing only one deviation compensator circuit (as shown in Figure 3) for each 'data line (ramp)' while at the same time allowing for at least temporarily connecting in parallel multiple light emitting elements and their associated circuitry that are connected to the same 'data line (ramp)'. Rather, the driving circuit and method of Pae necessarily requires individual closed feedback control loops for each and every light emitting element in a one-at-a-time manner. In Pae each and every light emitting element and its associated circuitry is exclusively connected to a deviation compensator circuit during the driving period, and the driving periods of the light emitting elements connected to the same 'data line (ramp)' are selected such that at any time only one light emitting element is controlled. If more than one light emitting element and its associated circuitry were operatively connected to the same 'data line (ramp)' simultaneously, and a single deviation compensator circuit were provided for that 'data line (ramp)', the light emitting elements could not be controlled independent from each other, because the first current, the voltage-converted current of which exceeds the threshold, would trigger the sample and hold circuit and prevent the ramp voltage applied to both light emitting elements through the 'data line (ramp)' from further changing. It is obvious that Pae tries to compensate the different individual properties of the current control means as to their voltage-current characteristic for properly and individually setting the current. Further, providing one deviation compensator with each pixel would significantly increase the number of components of the display and reduce the area available for

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emitting light – something that the person of ordinary skill in the art would avoid at almost any cost. It is always an object of engineers to increase the active area of a display, i.e. the area that emits light, and to keep the inactive area, i.e. the area that does not emit light, as small as possible. Taking Pae as a departure point it would not have been obvious to repeat the deviation compensator circuit shown in Figure 3 of Pae in each pixel of the display, because the number of components of that deviation compensator circuit is so large that it would drastically reduce the active area of the display. However, it is likewise not obvious to replace the deviation compensator circuit of Pae with a simple switch, because in that case the circuit of Pae would not function. Even if the deviation compensator circuit of Pae is replaced for each element of the display the result would be a number of independent control loops for each pixel on the display.

If, although not at all suggested in Pae, the deviation compensator circuit of Figure 3 were supplied with each and every light emitting element, Pae would still absolutely fail to disclose, teach or suggest that the input signal to the deviation compensator circuit of Figure 3, i.e. signal Vramp, is provided, in parallel, from the control electrode of a second current control means to a multiplicity of first current control means of a corresponding multiplicity of light emitting elements via a common control signal line, and that the multiplicity of first current control means and the second current control means at least temporarily form a corresponding number of current mirror circuits.

Even assuming arguendo that Pae reasonably suggests to one of ordinary skill in the art to connect a multiplicity of deviation compensator circuits to one controllable voltage source Pae still fails to disclose using a *current mirror* and even more so *splitting up the current mirror circuit* in such a way that one part of the current mirror can be coupled selectively, and at least temporarily in parallel, to a multiplicity of the complementary part of a current mirror (emphasis added).

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Applicant respectfully disagrees with Examiner in that the rather basic knowledge that a single voltage signal can drive the control terminals of multiple transistors in view of Pae renders the invention as claimed in the present application obvious. In view of Pae the person of ordinary skill in the art has to make many considerations, notably to add elements to each pixel, to replace a voltage source with a current mirror, and how to distribute the individual elements amongst the display in such a way that only a minimum number of relatively small components need to be provided with each and every pixel of the display (e.g. switching means 10, 12), while other components that possibly require larger space on a substrate need only be provided less often (transistors 21, 22, 23). Examiner's combination of Pae and common knowledge appears to involve improper hindsight in order to eventually arrive at the invention. Pae does not even provide the faintest motivation to add components to each pixel, to replace a voltage source with a current mirror, and to distribute the components as claimed in the present patent application. Applicant submits that the partitioning of the components itself constitutes an invention on its own and is not obvious nor a matter of simple choice to the person of ordinary skill in the art.

Kimura teaches, in Figure 44, a current supply circuit *placed in each pixel* (emphasis added; see col. 59, lines 19 and 20). Comparing figures 44 of Kimura and Figure 7 of the present application, the current supply of Kimura comprises a current supply transistor 112 that Examiner considers corresponding to the first current control means 4. Further, Examiner considers dot sequential transistor 1448 and current holding transistor 1444 of Kimura corresponding to first and second switching means 10, 12 that are connected in series between the feed to a control electrode of the first current control means 4. Current transistor 1445 of Kimura is considered corresponding to the second current control means 2. Current line CL of Kimura is considered corresponding to line ' i_{ramp} '. The current supply circuit of Kimura forms a current mirror circuit.

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Applicant maintains that although Kimura teaches a current mirror for setting a constant current nothing in Kimura discloses, teaches or suggests splitting up the two halves of a current mirror circuit in one part that is supplied with each pixel element, and another part that is supplied once for a multiplicity of pixel elements. In fact, Kimura explicitly teaches that the current supply circuit including a full current mirror is provided with each pixel, which adds to the complexity of the display circuit (see column 59, lines 19 and 20). Kimura also absolutely fails to selectively and at least temporarily connect two complementing halves of a current mirror circuits for a plurality of pixels.

There is a significant difference between connecting multiple control terminals of current control means to a common controllable voltage source and switchably connecting multiple control terminals of first current control means to a control terminal of one second current control means in such a way that at least temporarily a number of parallel current mirrors is created.

Further, the display circuit disclosed in Pae requires a completely different mode of operation than the display of Kimura. Pae discloses applying a voltage ramp signal to a current control means and comparing the resulting current with a reference, the reference being set to make the emitting pixel OEL emit light at a predetermined luminance (see column 5, lines 2 and 3). Thus, in Pae, the current through the current control means directly corresponds to the desired video signal.

In contrast to that, the amount of current flowing in the current supply circuit placed in each pixel of Kimura is controlled by a signal that is not a video signal and is always kept constant. A digital video signal is used to drive a switch portion in a pulse modulated manner (see column 12, lines 44 to 52).

The person of ordinary skill in the art would thus identify two completely different circuits requiring different driving methods in Pae and Kimura and conclude that

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combining the circuits is extremely difficult and not obvious even though lying in the same field of endeavour.

In view of the discussion above, Applicant maintains that both Pae and Kimura taken individually or in combination fail to disclose, teach or suggest using a two-part current mirror for driving elements of a light emitting display, wherein a first part of the current mirror is provided with each element of the light emitting display and a second part of the current mirror is provided for a multiplicity of elements of the light emitting display, and wherein the second part of the current mirror is connected with each of a multiplicity of first parts of the current mirror via two respective switching means.

Examiner's reasoning appears to be influenced by improper hindsight. Applicant respectfully disagrees with Examiner in that, at the time of invention, it would have been obvious to a person of ordinary skill in the art to improve the circuit of Pae by using a controllable voltage source comprising a transistor connected in a current mirror configuration as taught by Kimura as a replacement of the controllable voltage source of Pae. As discussed in the reply to the previous Office Action there is a significant difference between the two general driving methods for light emitting displays, voltage control or current control. The significant difference between the two general driving methods requires completely different circuits for each of the pixels of the light emitting display, and changing halfway from one driving method to the other driving method is something that the person of ordinary skill in the art would not consider. In fact, such a change itself would involve a significant inventive step and would not be obvious.

A first modification to the circuit of Pae requires that the deviation compensator circuit disclosed in Figure 3 of Pae be added to each and every pixel of the display disclosed in Pae. As per the discussion further above nothing in Pae discloses, teaches or suggests to do so. However, even if the person of ordinary skill in the art had made

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this modification to the circuit of Pae, still the inventive circuit of the present application would not be completed.

A second modification is required in order to come closer to the inventive display as claimed in the present application. The second modification requires that the voltage control of Pae be replaced with a current control as disclosed in Kimura, and that current mirror circuits are used for setting the desired luminance for each pixel of the light emitting display. As discussed in the reply to the previous Office Action there is a significant difference between the two general driving methods for a light emitting displays, voltage control or current control. The significant difference between the two general driving methods requires completely different circuits for each of the pixels of the light emitting display, and changing halfway from one driving methods to the other driving method is something that the person of ordinary skill in the art would not normally consider. In fact, such a change would involve a significant inventive step and would not be obvious. Also, as discussed further above, Kimura teaches setting a constant current that is pulse-modulated in response to the video signal, while Pae discloses a continuous current, the magnitude of which is directly set in response to the video signal. Modifying Pae with the teaching of Kimura would certainly teach away from the inventive circuit as claimed in the present application.

However, even if the person of ordinary skill in the art had made this further modification to the circuit of Pae, unlikely as it is, still the inventive circuit of the present application would not be completed.

A third modification is required in order to finally complete the inventive display as claimed in the present application. The third modification requires that current mirror circuit of the combination of Pae and Kimura is split into a first and a second part, the first part being provided with each individual pixel and the second part being provided once for a multiplicity of pixels.

The number of modifications to be applied to either the circuit of Pae or Kimura for finally completing the inventive circuit of the present application by itself is an indication for significant inventive activity. This holds true even more in view of the

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nature of the modifications. The first modification requires significantly increasing the number of components for each pixel, thereby reducing the active area that actually emits light, the second modification requires mixing two driving methods that mutually exclude each other, and replacing pulse modulation control of a constant current with directly controlling the magnitude of the current, and the third modification tries to reduce the negative impact of the first modification on the number of components in each pixel by trying to repartition the circuit into one part that can be used for a multiplicity of pixels and another part that must be provided with each pixel. This chain of modifications does not follow a straightforward route, and as such is not an obvious and stringent way of combining the prior art of Pae and Kimura.

The concepts of Pae and Kimura are so remote from each other that the person of ordinary skill in the art would not consider combining them, even though they are from the same field of endeavour. It is commonsense that there are combinations of known circuits from the same field of endeavour that produce new and inventive circuits. Otherwise, no patentable inventions would ever be possible in the field of electronics.

In view of the discussion above applicant submits that amended claim 17 is not obvious over Pae in view of Kimura and is allowable.

In view of the discussion above, the display of claims 17 and 27 is not obvious and is patentable over Pae in view of Kimura. Claims 18, 20, 22 and 28-29 are properly depending from allowable claims 17 and 27, respectively. As such, Applicant respectfully request that the Examiner withdraw the rejection to claims 17, 18, 20 and 22 and pass the claims to issue.

Likewise, the method recited in claims 23, 24 and 26 is also not obvious over the two references, since Pae teaches a closed loop control for a voltage drive control of the display, while Kimura teaches a control of the display using a constant current that

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is set once and then pulse modulated. These two control methods are completely different from each other and cannot be mixed with each other in order to obtain the method presented in the present application.

In view of the discussion above, the method of claims 23, 24 and 26 is not obvious and is patentable over Pae in view of Kimura. As such, Applicant respectfully requests that the Examiner withdraw of the rejection to claims 23, 24 and 26 and pass the claims to issue.

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Conclusion

Applicant respectfully submits that the amended pending claims patentably distinguish over the cited art and respectfully requests reconsideration and withdrawal of the 35 U.S.C. §103 rejection of the pending claims. Renewed reconsideration for a Notice of Allowance is respectfully requested.

Please charge any fees that may be due to Deposit Account No. 07-0832.

Respectfully submitted,

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